CLAIMS

1. A wireless communication system, comprising:

a user station comprising:

despreading circuitry for receiving and despreading a plurality of slots received from at least a first transmit antenna and a second transmit antenna at a transmitting station, wherein each of the plurality of slots comprises a first channel comprising a first set of pilot symbols and a second channel comprising a second set of pilot symbols;

circuitry for measuring a first channel measurement for each given slot in the plurality of slots from the first transmit antenna and in response to the first set of pilot symbols in the given slot;

circuitry for measuring a second channel measurement for each given slot in the plurality of slots from the second transmit antenna and in response to the first set of pilot symbols in the given slot; and

circuitry for measuring a phase difference value for each given slot in the plurality of slots in response to the first channel measurement and the second channel measurement for the given slot and in response to a ninety degree rotation of the given slot relative to a slot which was received by the despreading circuitry immediately preceding the given slot.

2. The wireless communication system of claim 1 wherein the user station further comprises circuitry for transmitting at least one weight value representative of the phase difference value to the transmitting station so that the transmitting station may operate to transmit at least one additional slot to the user station by weighting symbols in the at least one additional slot in response to the at least one weight value.

3. The wireless communication system of claim 2:

wherein the first set of pilot symbols comprises unweighted symbols; and

wherein the second set of pilot symbols comprises weighted symbols.

4. The wireless communication system of claim 3:

wherein the circuitry for measuring a phase difference value is operable with respect to a first slot in the plurality of slots, in a first instance, to measure the phase difference value in response to a whether a real portion of a complex dot product responsive to the first channel measurement and the second channel measurement is greater than or equal to zero; and

wherein the circuitry for measuring a phase difference value is operable with respect to a second slot in the plurality of slots, in a second instance immediately following the first slot, to measure the phase difference value in response to whether an imaginary portion of a complex dot product responsive to the first channel measurement and the second channel measurement is less than or equal to zero.

5. The wireless communication system of claim 3 wherein the user station further comprises beamformer verification circuitry for estimating, for each given slot in the plurality of slots, a phase difference weight value as applied to the weighted symbols of the given slot transmitted on the second transmit antenna by the transmitting station.

6. The wireless communication system of claim 5:

wherein the weighted symbols for each given slot comprise weighted pilot symbols; and

wherein the beamformer verification circuitry estimates the phase difference weight value, for each given slot in the plurality of slots, in response to the weighted pilot symbols for the given slot and in response to a product responsive to the second channel measurement and the second set of pilot symbols received from the second transmit antenna for the given slot.

7. The wireless communication system of claim 6 wherein the product is responsive to the second channel measurement in that the product is responsive to a weighting of the second channel measurement for the given slot and further in response to weighted ones of the second channel measurement for a plurality of slots received before the given slot and weighted ones of the second channel measurement for a plurality of slots received after the given slot.

8. The wireless communication system of claim 7:

wherein the user station further comprises circuitry for storing a measured phase difference value for a given slot; and

wherein the beamformer verification circuitry estimates the phase difference weight value, for a slot in the plurality of slots immediately following the given slot, further in response to a probability of feedback error and the stored measured phase difference value.

9. The wireless communication system of claim 6:

wherein the beamformer verification circuitry is further operable with respect to a first slot in the plurality of slots, and in a first instance, to estimate a first phase difference weight value as applied to the weighted symbols in the first slot, in response to maximizing an aposteriori detecting probability in response to one of two phase difference values consisting of a first phase difference value and a second phase difference value; and

wherein the beamformer verification circuitry is operable with respect to a second slot in the plurality of slots, and in a second instance following the first instance, to estimate a second phase difference weight value as applied to the weighted symbols in the second slot, in response to maximizing the aposteriori detecting probability in response to one of two phase difference values consisting of a third phase difference value and a fourth phase difference value; and

wherein the third and fourth phase difference values differ from the first and second phase difference values.

10. The wireless communication system of claim 9:

wherein the beamformer verification circuitry estimates the phase difference weight value, for each given slot in the plurality of slots, in response to a complex dot product of the weighted pilot symbols for the given slot with a product responsive to the second channel measurement and the weighted pilot symbols received from the second transmit antenna for the given slot;

wherein the beamformer verification circuitry is operable to estimate the second phase difference weight value in response to a whether a real portion of the complex dot product is greater than or equal to zero; and

wherein the beamformer verification circuitry is operable to estimate the first phase difference weight value in response to a whether an imaginary portion of the complex dot product is less than or equal to zero.

11. The wireless communication system of claim 10 wherein the beamformer verification circuitry is operable to estimate the phase difference weight value as an average of the first phase difference weight value with the second phase difference weight value.

12. The wireless communication system of claim 11 wherein the product is responsive to the second channel measurement in that the product is responsive to a weighting of the second channel measurement for the given slot and further in response to weighted ones of the second channel measurement for a plurality of slots received before the given slot and weighted ones of the second channel measurement for a plurality of slots received after the given slot.

13. The wireless communication system of claim 12:

wherein the user station further comprises circuitry for storing a measured phase difference value for a given slot; and

wherein the beamformer verification circuitry estimates the phase difference weight value, for a slot in the plurality of slots immediately following the given slot,

further in response to a probability of feedback error and the stored measured phase difference value.

14. The wireless communication system of claim 10:

wherein the user station further comprises circuitry for determining a channel estimate for slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot, wherein the channel estimate is determined in response to a sum of a first addend with a second addend;

wherein the first addend comprises a first product responsive to the second channel measurement and the second phase difference weight value;

wherein the second phase difference value is normalized with respect to the first phase difference weight value; and

wherein the second addend comprises a second product responsive to the first channel measurement and the first phase difference weight value.

15. The wireless communication system of claim 14 wherein the user station further comprises maximal ratio combining circuitry for processing the slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot in response to the channel estimate.

16. The wireless communication system of claim 14:

wherein the first product is responsive to the second channel measurement in that the first product is responsive to a weighting of the second channel measurement for the given slot and further in response to weighted ones of the second channel measurement for a plurality of slots received before the given slot and weighted ones of the second channel measurement for a plurality of slots received after the given slot; and

wherein the second product is responsive to the first channel measurement in that the product is responsive to a weighting of the first channel measurement for the given slot and further in response to weighted ones of the first channel measurement for a plurality of slots received before the given slot and weighted ones of the first channel measurement for a plurality of slots received after the given slot.

17. The wireless communication system of claim 15 wherein the user station further comprises maximal ratio combining circuitry for processing the slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot in response to the channel estimate.

18. The wireless communication system of claim 6 wherein the beamformer verification circuitry is further operable with respect to each given slot in the plurality of slots to estimate the phase difference weight value as applied to the weighted symbols in the given slot, in response to maximizing an aposteriori detecting probability in response to one of four different phase difference values.

19. The wireless communication system of claim 18:

wherein the beamformer verification circuitry estimates the phase difference weight value, for each given slot in the plurality of slots, further in response to a complex dot product of the weighted pilot symbols for the given slot with a product responsive to the second channel measurement and the weighted pilot symbols received from the second transmit antenna for the given slot;

wherein the beamformer verification circuitry further comprises circuitry for multiplying each of the one of four different phase difference values as a corresponding multiplicand times the product; and

wherein the beamformer verification circuitry further estimates the phase difference weight value as the corresponding multiplicand that results in a largest product.

20. The wireless communication system of claim 19 wherein the product is responsive to the second channel measurement in that the product is responsive to a weighting of the second channel measurement for the given slot and further in response to weighted ones of the second channel measurement for a plurality of slots received before the given slot and weighted ones of the second channel measurement for a plurality of slots received after the given slot.

21. The wireless communication system of claim 20:

wherein the user station further comprises circuitry for storing a measured phase difference value for a given slot; and

wherein the beamformer verification circuitry estimates the phase difference weight value, for a slot in the plurality of slots immediately following the given slot, further in response to a probability of feedback error and the stored measured phase difference value.

22. The wireless communication system of claim 19:

wherein the user station further comprises circuitry for determining a channel estimate for slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot, wherein the channel estimate is determined in response to a sum of a first addend with a second addend;

wherein the first addend comprises a first product responsive to the second channel measurement and the second phase difference weight value;

wherein the second phase difference value is normalized with respect to the first phase difference weight value; and

wherein the second addend comprises a second product responsive to the first channel measurement and the first phase difference weight value.

23. The wireless communication system of claim 22 wherein the user station further comprises maximal ratio combining circuitry for processing the slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot in response to the channel estimate.

24. The wireless communication system of claim 22:

wherein the first product is responsive to the second channel measurement in that the first product is responsive to a weighting of the second channel measurement for the given slot and further in response to weighted ones of the second channel measurement for a plurality of slots received before the given slot and weighted ones of the second channel measurement for a plurality of slots received after the given slot; and

wherein the second product is responsive to the first channel measurement in that the product is responsive to a weighting of the first channel measurement for the given slot and further in response to weighted ones of the first channel measurement for a plurality of slots received before the given slot and weighted ones of the first channel measurement for a plurality of slots received after the given slot.

25. The wireless communication system of claim 24 wherein the user station further comprises maximal ratio combining circuitry for processing the slots received from the first transmit antenna and the second transmit antenna and corresponding to a same time slot in response to the channel estimate.

26. The wireless communication system of claim 1 wherein the first channel measurement, the second channel measurement, and the phase difference values are measured in a first closed loop mode of operation in response to a first rate of Doppler fading, and wherein the user station further comprises circuitry for operating in a second closed loop mode of operation in response to a second rate of Doppler fading.

27. The wireless communication system of claim 26 wherein the user station further comprises circuitry for transmitting, in the second closed loop mode, both amplitude and phase correction bits to the transmitting station so that the transmitting station may operate to transmit at least one additional slot to the user station in response to the amplitude and phase correction bits.

28. The wireless communication system of claim 3 and further comprising the transmitting station, wherein the transmitting station comprises:

circuitry for weighting symbols to form weighted symbols in response to a feedback channel weight value responsive to the at least one weight value; and

circuitry for transmitting the weighted symbols in a slot to the user station.

29. The wireless communication system of claim 3 and further comprising the transmitting station, wherein the transmitting station comprises:

circuitry for weighting symbols to form weighted symbols in response to a feedback channel weight value responsive to an average of two weight values communicated from the user station to the transmitting station in response to two slots received by the user station over two successive time slots; and

circuitry for transmitting the weighted symbols in a slot to the user station.

30. The wireless communication system of claim 1 wherein the user station comprises a WCDMA user station.

31. A wireless communication system, comprising:

a user station comprising:

despreading circuitry for receiving and despreading a plurality of slots received from at least a first transmit antenna and a second transmit antenna at a transmitting station, wherein each of the plurality of slots comprises a first channel comprising a first set of pilot symbols and a second channel comprising a second set of pilot symbols;

circuitry for measuring a first channel measurement for each given slot in the plurality of slots from the first transmit antenna and in response to the first set of pilot symbols in the given slot;

circuitry for measuring a second channel measurement for each given slot in the plurality of slots from the second transmit antenna and in response to the first set of pilot symbols in the given slot;

circuitry for measuring a phase difference value for each given slot in the plurality of slots in response to the first channel measurement and the second channel measurement for the given slot and in response to a predetermined degree rotation of the given slot relative to a slot which was received by the despreading circuitry immediately preceding the given slot; and

beamformer verification circuitry for estimating, for each given slot in the plurality of slots, a phase difference weight value as applied to the first set of pilot symbols of the given slot transmitted on the second transmit antenna by the transmitting station.

32. A method of operating a wireless communication system, comprising the steps of:

receiving and despreading a plurality of slots received from at least a first transmit antenna and a second transmit antenna at a transmitting station, wherein each of the plurality of slots comprises a first channel comprising a first set of pilot symbols and a second channel comprising a second set of pilot symbols;

for measuring a first channel measurement for each given slot in the plurality of slots from the first transmit antenna and in response to the first set of pilot symbols in the given slot;

measuring a second channel measurement for each given slot in the plurality of slots from the second transmit antenna and in response to the first set of pilot symbols in the given slot; and

measuring a phase difference value for each given slot in the plurality of slots in response to the first channel measurement and the second channel measurement for the given slot and in response to a ninety degree rotation of the given slot relative to a slot which was received by the despreading circuitry immediately preceding the given slot.

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